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TRAINING OF GEOLOGISTS AND TECHNICIANS
FOR OIL EXPLORATION AND REFINING

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TRAINING OF GEOLOGISTS AND TECHNICIANS
FOR OIL EXPLORATION AND REFINING

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I. THE APPROACH TO OIL DEVELOPMENT IN INDIA.

The demand for oil products.

1. The demand for petroleum products in India rose from 2.2 million tons in 1948 to 7.7 million tons in 1960 and to about 8.4 million tons in 1961. The demand estimate for 1965-66 is 14 million tons, but if the more recent rate of growth is a good guide, the demand may actually go up to about 17 million tons by then. An annual demand of about 25 million tons by 1970-71 and of 40 million tons by 1975-76 may, therefore, be regarded as conservative. The cumulative consumption of crude oil over the next 15-year period would thus be about 325-350 million tons. Were all this imported, the cost at current prices may be Rs. 26000-28000 millions. Apart from the heavy drain on foreign exchange involved in imports on this scale, the difficulties likely to arise in times of emergency may hinder industrial activity and produce an adverse effect on national security.

The need for a planned approach.

2. In view of the vital importance of petroleum as a source of energy and as a raw-material for industry, and of the dependence of the petroleum industry on other key industries, the need for formulating a comprehensive and well-balanced programme for the oil industry, in the context of an integrated long-term plan of economic development, is self-evident. This is confirmed by the experience of the Rumanian oil industry, which was able to recover from a continuous fall in production (from 8.7 million tons in 1938 to less than 3 million tons in 1945) only after embarking on a planned development of her economy; now the output of the Rumanian oil industry is nearly 12 mil. tons/year. Rumanian and Indian experiences tend to show that when the responsibility for the search for oil is entrusted to foreign interests, the results may be unsatisfactory from a national view-point. In both countries, a spectacular rise has occurred only when these activities came under governmental responsibility.

3. Under present conditions, for developing countries such as India, the national government must assume a major responsibility for the development of its petroleum industry, and particularly of exploration as a national service in a vital sphere. Keeping the above broad considerations in view, the Government of India have included "Mineral Oil" under Schedule "A" in their Industrial Policy Resolution of April 1956. In the result, the future development of the petroleum industry in this country will be the exclusive responsibility of the State. This policy, however, does not exclude and has not in actual practice excluded the participation of private interests jointly with the State in exploration and other activities in a manner that is conducive to

national interest.

4. In a plan of development for the oil industry, it is necessary for the State to make adequate provision for geological and geophysical work, as well as extensive and intensive exploratory activity, on a continuous basis, till the oil and gas potentialities of the sedimentary basin are evaluated in a convincing manner. For carrying out such a plan, substantial financial resources, large quantities of different types of equipment and large numbers of technical personnel trained for various specialised jobs will be required. The experiences of the Rumanian and Indian petroleum industries provide ground for believing that financial resources will be forthcoming; that equipment can be obtained from friendly countries abroad and can also be increasingly manufactured indigenously; and that a new generation of young men can learn the skills rapidly. In Rumania, for example, up to 1948, all the oil equipment was imported. Now, the country's machine building industry produces all kinds of oil equipment for its own needs and for export.

5. While some results can be accomplished with smaller financial resources and limited equipment, no progress can be expected in the absence of suitably trained manpower. Well-coordinated and continuous technical training programmes for the petroleum industry are, therefore, of supreme importance. If effective and timely measures in this matter are not taken, the industry may be unable to fulfil its urgent tasks during the Third Five Year Plan, and future development programmes, aimed at seeking self-sufficiency during the Fourth and Fifth Five Year Plans, will also be seriously jeopardised.

International Cooperation.

6. When the Government of India decided to take up oil exploration and refining as public sector activities, Rumania and the Soviet Union, possessing well-established petroleum industries, first came to India's help with equipment and technical and financial aid on a large scale. As a result, about 38 drilling rigs, a good deal of lifting, transporting, workshop and production equipment, and equipment for the establishment of a refinery capacity of 4.75 million tons have been or will be made available during the Third Five Year Plan. These countries have also given the services of their specialists and facilities for training Indian personnel in their institutes and oil fields. The Governments of several other countries and international agencies have also provided scholarships for training Indian personnel. Latterly, credit facilities and technical assistance have been offered by the Government of France and Ente Nazionale Idrocarburi (ENI) for carrying out specific exploratory jobs on a contract basis and for other oil developments.

II. TECHNICAL MANPOWER REQUIREMENTS.

A fifteen year perspective of development.

7. It was stated in paragraph 1 that, if India's estimated crude requirements over the next 15-year are to be met wholly by import and expenditure of Rs.26000-28000 millions, most of it in foreign exchange, will have to be incurred. The objective of achieving self-sufficiency in petroleum products during this period must be regarded as economically desirable; and an investment of at least Rs.25,000 millions during the Third, Fourth and Fifth Five Year Plan would be a sound proposition. On the basis that investment of this magnitude is practicable and that an annual production of about 35-40 million tons of oil by 1975-76 can be obtained from India's sedimentary basins, it is considered that a development programme of the following magnitude may be necessary for

achieving long-term objectives:

Table 1.

Items	1965-66	1970-71	1975-76
(a) Geological parties	20	25	25
(b) Seismic parties	30	50	60
(c) Number of deep drilling rigs	52	120	240
(d) Meterage to be drilled (million meters)	1.2	3.8	10.5
(e) Number of new oil fields, each with an annual production of 2 million tons to be constructed.	4	4.5	5.6
(f) Additional refinery capacity to be installed (million tons)	4.75	12	15

9. The technical manpower requirements have been worked out on the basis of the following norms based on recent Indian experience :

Table 2.

Items of work	Unit	Persons with	
		Higher Education	School Education
(a) <u>GEOLOGICAL & GEOPHYSICAL EXPLORATION.</u>			
i) Geophysical field work	Persons/party	4	4
ii) Gravity-cum-magnetic work	- do -	5	8
iii) Seismic work	- do -	6	23
iv) Electrologging work	- do -	6	7
(b) <u>DEEP DRILLING.</u>			
i) Operation of deep drilling rigs.	Persons/rig	12	55
ii) Well-site geology	- do -	5	4
iii) Workshop facilities (at drillsite and for manufacture & capital repairs)	- do -	12	60
(c) <u>PRODUCTION.</u>			
i) Oil field construction	Persons/2 million oil field.	70	425
ii) Operation of work-over rigs	Persons/rig.	8	30
iii) Current production and oil-field maintenance	Persons/2 million oil field.	75	37 ^e
(d) <u>REFINING.</u>			
i) Construction	Persons/2 million ton refinery.	180	1800
ii) Operation and maintenance	- do -	300	960

10. The technical manpower requirements of the public sector oil industry over the 15-year period (1961-1976), as estimated on the basis of the norms adopted, are tabulated

in the following table :

the following table:

Table 3.

Item of work.	Actual position on 31-3-1962		Total requirement by					
			1965-66		1970-71		1975-76	
(a) Persons with higher education.								
		%		%		%		%
Geological	310	27	840	20	1420	13	2460	13
Geophysical	254	23	446	11	758	7	1198	6
Drilling	329	29	1404	33	3240	29	6480	34
Production	33	3	394	9	1386	12	2190	12
Refining	202	18	1160	27	4290	39	6540	35
Total of (a)	1128	(100)	4244	(100)	11094	(100)	18868	(100)
(b) Persons with school education.								
Geological	309	10	784	5	1640	4	2480	4
Geophysical	375	12	1025	6	1633	4	2125	3
Drilling)	1592	64	6760	41	15600	37	31200	448
Production)			1600	10	5963	14	8775	14
Refining	447	14	6160	38	17400	41	19800	31
Total of (b)	3123	(100)	16329	(100)	42236	(100)	64380	(100)
Total of (a) & (b)	4251		20573		53330		83248	

Approach to the problem of technical training.

11. The efforts so far made by the Government of India to bridge the gap and the steps proposed to be taken to enlarge the availability of the necessary personnel are detailed below.

12. Foreign Experts. During the initial stages of oil exploration, production and refining in the public sector, when only a small number of Indians were familiar with the requisite skills, the assistance of experts from foreign countries was inescapable. Thus, in 1956-57, 58 foreign experts, including 21 from Rumania and 31 from the Soviet Union were invited to India. During 1960-61 and 1961-62, on an average, about 274 foreign experts - 170 from the USSR, 89 Rumanians and the rest from other countries - have been helping in exploration, production and refining operations. But the accumulation of experience and the returns from the proposed institutes and training centres are expected to substantially reduce the requirements of foreign personnel in due course.

Training of Indian personnel in foreign countries.

13. By the 31st March 1962, about 308 Indians have been trained for the oil industry in the USSR, Rumania, U.K., USA, Germany, France, Italy, Hungary and Iran. As a result of this foreign training and of the training imparted within the country, a sufficient number of specialists have been made available for carrying out basic geological, geophysical, drilling and refining operations for present needs. Hereafter, it will be necessary to send Indians abroad only for training in fields for which facilities do not exist within the country or cannot be created in the near future.

Expansion of training facilities in India.

14(a) The public sector oil industry has now reached a stage of development which demands a large number of specialists and technicians. Adequate and timely measures have, therefore, to be taken for expanding the existing training facilities and creating new ones. Some steps in this direction have already been taken. Thus, a number of

universities and institutes have introduced degree and post-graduate courses in geology, and six universities have made arrangements for specialisation in various branches of pure and applied geology and geophysics. The drilling school of the oil & Natural Gas Commission, which started functioning at Dehra Dun in May 1961, is producing about 50 drilling personnel per year.

(b) Arrangements have been made to establish a Research and Training Institute under the Oil & Natural Gas Commission, with aid from United Nations Special Fund. It will offer training facilities in petroleum geology, geophysics, logging techniques, mud and cementation and drilling and production to university graduates specially selected for this purpose; it will also undertake applied research and organise refresher courses for Oil & Natural Gas Commission personnel engaged in oil exploration, development and production.

(c) An Indian Institute of Petroleum has been set up under the Ministry of Scientific Research & Cultural Affairs and the Council of Scientific and Industrial Research with aid again from the United Nations Special Fund. This institute will deal with the research and training problems connected with the evaluation, refining and processing of crudes, transporting and marketing, testing of finished products and the optimum utilisation of by-products with special reference to the establishment of a petro-chemical industry. A training wing of the IIP will have facilities for training 100 persons at a time.

(d) The Oil & Natural Gas Commission has established three training institutes at Cambay, Bareilly and Sibsagar for training welders, fitters, mechanics, operators, etc. To begin with, these three institutes together will turn out about 400 technicians per year. But the capacity of the institutes is proposed to be augmented in the near future.

15. A comparison of the requirements and the availability of technical manpower for the Indian oil industry, as a result of the measures taken so far indicates that further steps are necessary to meet requirements in three categories, viz. (a) drilling and production engineers and refinery operators; (b) technicians with school education; and (c) engineers for design and project work.

16(a) During the Third Five Year Plan, the requirements of drilling and production engineers will have to be met, as in the past, by recruiting suitable science graduates and engineering graduates or diploma holders and imparting on-the-job training to them. It may, however, be better to set up a separate institute for training drilling and production engineers. Such an institute would impart instruction over a 4/5 year period of under-graduate study in a specially prepared curriculum in basic engineering subjects and drilling, production, etc. in an integrated manner. The desired annual out-turn of the Institute may be of the order of 200 drilling engineers and 125 production engineers, to begin with, and 300 drilling engineers and 125 production engineers by 1970-71.

(b) The Third Plan requirements of refinery operators will have to be met by training 400 science and engineering graduates in centres attached to the existing refineries. During the Fourth and Fifth Plans, these centres can turn out more than 100 trained operators per year, a number sufficient to meet requirements. In Rumania the geologists and engineers for all sectors of the oil industry are trained at the "Oil, Natural Gas and Geological Institute". From its foundation on 1948, more than 2,000 geologists and engineers, many of them from foreign countries have graduated from the Institute.

17. Training of technical personnel with school education.

During the Third Five Year Plan, India as a whole will require about 1.3 million craftsmen. The petroleum industry's requirement of about 16,000 technical personnel with secondary education during this plan period can be met, if at least 50 % are

trained within the industry itself. As mentioned earlier, three training institutes one each in Gujarat, Uttar Pradesh and Assam have already been started. It will be necessary to attach such institutes to each oil field, workshop and refinery that will be put into operation over next three plan periods, so as to raise the total annual out-turn to over 3,000. In Rumania the training of technicians on a medium level is made in 10 technical schools, located at the important centres of the oil industry, which prepare the specialists for all the branches of the oil industry. The duration of the course is 3 years. Qualified workers, for all professions necessary in the oil industry, are trained in 18 technical schools for apprentices, where students with 7 years education (age limit 14 to 16 years) are allowed to enter; the training lasts 3 years. In every oil field and refinery, there are technical schools for training such skilled workers as have experience of at least 1 year.

Training of engineers for design and project work.

18. The continuous construction of oil fields, refineries and equipment, as well as the continuous modernisation of these activities, require the setting up of Design and Projecting Units. In Rumania, there are two Research Institutes and two Project Institutes as follows:

The Research Institute for Drilling and Extraction, Cimpina;
The Research Institute for the Refining of Oil & Petrochemistry
(Petrochim), Ploiesti;
The Institute for the Designing of oil fields, Ploiesti;
Designing Oil Installations Institute, Ploiesti.

These institutes are covering all the requirements of the oil industry and are guiding all the related activities on the technical-scientific plane. In India a beginning in this direction has already been made at the Research and Training Institute and at the Indian Institute of Petroleum at Dehra Dun; similar units may also be organised as adjuncts to different oil enterprises.

III. INDO-RUMANIAN COOPERATION IN THE OIL INDUSTRY

The origin of Rumanian assistance.

19. Rumanian cooperation in the last few years in India's development of the oil industry has covered a wide and comprehensive field of activity. The Rumanian oil industry has a long history and has reached a high level of development. It operates more than 200 rigs, produces about 12 million tons of crude per year and has a refinery capacity of over 12 million tons per annum. In addition, in 1961 it produced 96 drilling rigs and allied drilling equipment, all types of production equipment, and more than 37,000 tons of technological equipment for the chemical industry and for crude oil processing.

20. The visit of an Indian delegation, led by Shri K.D. Malaviya, then Minister for Mines & Oil, Government of India, to Rumania (and the USSR) in the summer of 1955 can be regarded as the starting point of foreign collaboration in launching India's oil industry on its new career of a Government activity. In the winter of the same year, the first blue print of a plan for oil exploration in India during the Second Five Year Plan was drawn up.

Rumanian assistance for exploration drilling.

21. In view of the Government of India's obvious interest in oil developments, the Rumanian Government sent a deep drilling rig for demonstration at the Indian Industries Fair held in New Delhi towards the close of 1955. In March 1956, this rig was purchased

by the Oil & Natural Gas Commission and was used for drilling Jawalamukhi No.1, the first well to be drilled by the public sector oil industry in India. From then onwards, Rumanian technicians have been actively associated with exploration and drilling activity in this country. In the beginning of 1956-57, 21 Rumanians were assisting in carrying out drilling operations. At present the number of Rumanian rigs in use in India is 7. In addition to these rigs and their accessories and spare parts, the Rumanian Government has supplied workshop and other equipment also.

22. By the beginning of the Third Five Year Plan, the number of Rumanian technicians working in India had increased to 38. The fact that, though during the last 6 years, the number of Rumanian rigs has increased from 1 to 7, and that, nevertheless, the number of Rumanian technicians rendering assistance to operation has increased relatively to a small extent only indicates the sustained and continuous efforts made by Rumanian experts in helping Indian personnel to learn the drilling techniques rapidly. A notable feature of the deputation of Rumanian technicians to India for oil exploration as well as for refining is the comparatively modest cost of the services, particularly with reference to the emoluments payable to them.

Rumanian assistance for refining.

23. Following the discovery of the Nahorkatiya and Moran oil fields in Assam in the fifties, the Government of India decided to set up two public sector refineries, one each in Assam and Bihar, for processing the crude. This was followed by an approach to many countries, possessing experience in oil refining for assistance in launching these enterprises. At this juncture, in February 1958, the Rumanian Prime Minister, then on a visit to India, made a generous offer of technical and financial aid in setting up a refinery at Gauhati in Assam, the first refinery in India's public sector oil industry. In accordance with an Indo-Rumanian Agreement signed in October 1958, the Government of Rumania undertook to design the refinery, supply plant and equipment, depute Rumanian technicians to assist in the construction and commissioning of the refinery and receive Indian technicians in Rumania for training in the design, erection and operation of refineries. A credit of Rs. 5.23 crores, at 2½ % interest repayable in 7 years, was also made available.

24. According to the training programme drawn up, 54 Indians were trained for periods of 4 to 12 months. For about three months, the trainees studied theoretical courses at the Institute of Petroleum, Gas and Geology, Bucharest. The trainees were also given practical training in their respective specialities at the various refineries under construction or operation in Rumania. Besides training on the working of the various units, which were to be provided in the Gauhati Refinery, the practical training included maintenance, shut-down planning, training in instrumentation, fire fighting, equipment inspection, cost estimating, oil accounting, storage and loading and work on specific design problems at the Design Institute of Ploiesti. During the training period all the trainees were given periodic tests and reports on their progress and performance were kept on record.

25. Under the Indo-Rumanian agreement for the setting up of the Refinery, 56 Rumanian experts were deputed to India for assistance in refinery construction and erection. Some of these and new ones, totalling 52 in all, were also made available for the testing and commissioning of the refinery.

Results of the cooperation.

26. As mentioned earlier, Rumanian assistance has enabled India to own and operate the very first rig and the very first refinery in the public sector oil industry. Nor

was the assistance merely well-begun. It has continued over the last six years in the spirit of helping the development of an important industry in a friendly country and has produced very fruitful results. The fact that the Rumanian Government is not only continuing the process of technical assistance, but is also taking a keen interest in the technical manpower training programmes, indicates Rmania's genuine desire to speed the progress of India's oil industry. The assistance has, moreover, been given on a basis which permits the fulfilment of mutual interests and maintains equality between aid-giving and aid-receiving countries.

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